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SPACE WEAPON SYSTEMS: A LOOMING PROLIFERATION THREAT

INTRODUCTION

When General Norman Schwarzkopf sent his ground forces on a deceptive end-run into southern Iraq on the first day of the 1991 Gulf War, he knew that it was nearly impossible for the Iraqis to track their movements. The result was a stunning surprise attack that enveloped and cut off the Iraqi army. But what if the Iraqis had possessed satellite surveillance systems capable of monitoring allied troop movements? While it might not have altered the outcome of the war, it might well have forced Schwarzkopf to launch a direct assault into the teeth of Iraqi defenses.

In addition to a lack of surveillance systems, Iraq also could not field satellite communications systems. This allowed the U.S. to attack and destroy Saddam Hussein's ground-based communication systems and thereby cut off Iraqi forces in the field from command centers in Baghdad. Similarly, the absence of satellite systems deprived Iraqi forces of the ability to navigate precisely or to forecast the region's erratic weather. Partly as a result of its virtual monopoly on satellite systems, and all the advantages they confer, America wrapped up the war quickly and with fewer losses than could have been anticipated. Without this advantage allied casualty levels would have been dramatically higher.[1]

Saddam Hussein understood the military advantages of satellite systems even before the Persian Gulf War. For example, he tested a three-stage ballistic missile in 1989 and was trying to obtain satellite technology for reconnaissance from Brazil, China, and France.

In addition to Iraq, such countries as Brazil, India, and Israel currently are developing impressive space launch and satellite capabilities. As these technologies spread, it is increasingly likely that in coming years America will find itself facing a military adversary in space. Like nuclear weapons or other weapons of mass destruction, space

1 Rockwell International Corporation has estimated that the allied casualty levels could have soared to 120,000 if Iraq possessed earth observing satellites. See: *The Persian Gulf War...What It Was...What It Might Have Been*, unpublished paper, p. 7.

systems can be a powerful military "equalizer" in the hands of a relatively inferior military force. Space systems can increase the accuracy of weapons and improve the control over the movement of forces.

The possibility that military space systems will proliferate to such potentially hostile regimes as Iraq and North Korea presents a tricky problem for the U.S. and other spacefaring nations. Developing nations have legitimate needs for access to space launch systems and satellite services for such non-military purposes as communication and navigation. Another need is to observe the earth visually or with radar to help find natural resources. At the same time, most developed and developing nations share an interest in preventing the spread of space technology—much of which has some military applications—to dictatorial aggressor regimes.

In order to address the emerging threat posed by the proliferation of military space systems, George Bush should devise a new strategy to prevent the proliferation of space technology while ensuring access to commercial space services for advanced as well as developing nations. Toward this end, Bush should:

- **Strengthen arms control measures restricting the proliferation of space launch systems.** The U.S., along with seventeen other countries, controls the export of missile technology to Third World countries under a cooperative arrangement called the Missile Technology Control Regime (MTCR). But the MTCR explicitly states that controls placed on the export of ballistic missile technology are not meant to impede Third World space programs, regardless of whether they are military or not. The MTCR's exception is tantamount to a green light for the development of military space capabilities by non-spacefaring countries. This exception should be eliminated from MTCR guidelines.

- **Propose a Space Technology Cooperation Initiative.** To give non-space countries an incentive to cooperate in limiting proliferation, the U.S. should seek a multilateral agreement that assures developing countries access to existing satellite services for peaceful purposes in exchange for commitments from them not to deploy their own satellites.

- **Develop the means to counter enemy satellite systems by building and deploying an anti-satellite weapon.** Given the threat posed to U.S. troops by potential enemy military satellites, or even civilian satellites with military applications, the U.S. will need the capability to enforce a military "keep out" zone in space over a battle area. Right now, the U.S. has no operational weapons capable of shooting down enemy satellites and its ASAT research and development program is moribund. It should be resuscitated. Other approaches to denying an enemy access to satellite data, such as jamming satellite signals, also should be further developed.

- **Develop a national policy to secure U.S. commercial satellite signals, including in some cases encrypting commercial satellite data.** Some of America's most sophisticated military satellites—in particular the Global Positioning Satellite (GPS) system, which tells U.S. air, land, and sea forces their precise location—do double duty as civilian systems, for example, in shipping and airline industries. And many commercial satellite systems, such as resource monitoring satellites, also can have military utility, since their data are made readily available to anyone possessing a ground station receiver. U.S. commercial satellite operators should be required to have the ability to "encrypt," or scramble in code, all signals from their satellites—when requested for national security reasons by the President—so that enemy forces cannot make use of their data, possibly putting U.S. forces in danger. The U.S. should seek treaties with other friendly spacefaring nations to restrict access to their satellite services in times of conflict.

America's advantage in military space systems is a vital component of its overall military strength. It is in America's interest that this advantage be preserved. These measures in combination will discourage potentially hostile non-space countries from entering into a race for space access. They also will give the U.S. military options to counter threats in space in the event that efforts to control space system proliferation fail.

HOW THE MILITARY USES SPACE

Space systems are used for a variety of military purposes. They gather intelligence, help to command and control forces, serve as communication links, defend against missile attack, forecast the weather, and assist in navigation. The U.S. now reigns supreme in space systems, with Russia—in conjunction with the Commonwealth of Independent States—still maintaining a robust military space capability. No other country has substantial military space assets, although China and the Europeans (through the European Space Agency) have less extensive capabilities for communication and earth monitoring.[2]

The most sensitive, and therefore secretive, systems are those used for gathering intelligence. The U.S. depends heavily on surveillance satellites to obtain information on weapons tests, the location of command posts, weapons, troops and military equipment, assessing bomb damage during wartime, and eavesdropping on communications between enemy forces.[3] Most prominent among satellites used by the U.S. military for intelligence gathering are earth-observing satellites, such as the KH-12, which produces high-resolution images of the earth's surface for U.S. military forces. This allows the U.S. to know the size and characteristics, for example, of enemy forces. These types of satellites are called "signal intelligence" satellites because they collect the electronic signals emitted by enemy communication systems and other electronic equipment. These also monitor the telemetry, or electronic information, emitted by missiles when they are launched.

U.S. military satellite systems are essential to tying together sometimes far-flung forces for purposes of command, control, and communications. The importance of

2 The European Space Agency is a consortium of thirteen countries, including Austria, Belgium, Denmark, France, Germany, Great Britain, Holland, Ireland, Italy, Norway, Spain, Sweden and Switzerland.

3 While some earth-observing satellites deployed by the U.S. do take photographic pictures of locales on earth, others produce radar or infrared images.

command, control, and communications—or C^3—was demonstrated clearly in the Gulf War, when the U.S. was able to cut off communications—mainly by attacking command posts and land communication lines—between Iraqi commanders and forces in the field. The result was confusion, loss of command, desertion, and ultimately defeat for the Iraqi forces. Satellite communications are extremely difficult to disrupt since no country (except perhaps Russia) possesses an operational system for destroying satellites. Moreover, satellite signals can be difficult to jam.

Critical Tool. Satellite communications are particularly important for the U.S., which has forces stationed around the globe and fights virtually all its battles far from its own shores, often in areas where local communication systems are primitive. In its July 1991 interim report on the conduct of the Persian Gulf War, the Pentagon commented officially on the use of satellite communication systems during Operations *Desert Shield* and *Desert Storm*:

> At the outset of hostilities, the Defense Satellite Communications System (DSCS) provided 75 percent of all inter-theater connectivity and was used extensively to support intra-theater requirements covering troop deployments over long distances not supportable by terrestrial systems.[4]

DSCS was not the only satellite network used for command, control, and communications support during the Gulf War. Even such civilian networks as the International Telecommunications Satellite Organization (Intelsat) system were used.[5] The loss of satellite communications would have caused a serious setback in the conduct of the Persian Gulf War.

Early-warning satellites, which detect the exhaust plumes of ballistic missiles and relay electronic information about them to ground controllers, are an integral part of U.S. space capabilities. These systems, too, played an important role in the Gulf War. The extraordinary performance of the *Patriot* missile system in shooting down Iraqi *Scud* missiles in the Persian Gulf War would have been severely hampered without the vital support of such early warning systems as the Defense Support Program (DSP) satellite system. DSP satellites were used to detect Iraqi *Scud* launches and provide initial warning to the operators of *Patriot* batteries in Israel and Saudi Arabia.[6] This enabled them to anticipate and eventually destroy incoming missiles. Even more effective defenses against battlefield and longer-range ballistic missiles are under development as successors to the *Patriot* missile, and they will require yet more advanced sensors based in space.

Navigation Aid. Historically, and especially on today's fast-moving battlefield, the ability to orient and coordinate often dispersed forces can be the difference between victory and defeat. The U.S. military now has a constellation of satellites, known as the Global Positioning System (GPS), that can tell troops on the ground, in the air, or at sea, their location anywhere on the globe to within less than 32 feet. The satellites

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4 The Department of Defense, *Conduct of the Persian Gulf Conflict, An Interim Report to Congress* (Washington, D.C.: GPO, 1991), p. 15-2.

5 Intelsat is a multilateral organization that operates a fleet of commercial communications satellites.

6 For a brief description of how DSP satellites supported *Patriot*, see: Craig Covault, "USAF Missile Warning Satellites Providing 90-Sec. Scud Attack Alert," *Aviation Week & Space Technology*, January 21, 1991, pp. 60-61.

serve as artificial stars, their beacons fixing the position of any troops carrying receivers. GPS was used extensively and to tremendous advantage by U.S. forces in the war against Iraq, where barren desert terrain held few natural landmarks.

Forecasting. A main variable, and therefore risk factor, in war is the weather. Low clouds can hinder a bombing operation; the same clouds might assist ground operations by providing cover from surveillance aircraft. Precision weather forecasting provides an important advantage to U.S. forces, which are able to rely on sophisticated satellite systems. Commander-in-Chief of U.S. Space Command Donald J. Kutyna commented on the use of weather satellites in the Gulf War:

> [It was]...the worst flying weather...[in the Middle East] in years. So weather was extremely important. Your weather satellites, flown out of Falcon Air Force Base [Colorado], were providing [weather information] in almost real time to several terminals on the ground. The Army, the Navy, the Air Force all had weather terminals and they got it directly from the satellites.[7]

In sum, the Persian Gulf war was a mismatch largely because U.S. forces dominated space. From communications to forecasting the weather, space systems gave American forces an edge that the Iraqis could not overcome. Potential U.S. adversaries undoubtedly have learned a lesson from Iraq's misfortune. Such countries as North Korea, Iran, and Libya certainly will be redoubling their own efforts in coming years to develop space systems, or gain access to existing systems, and break America's near monopoly in military space systems. The U.S. must respond effectively to this challenge or squander an important military advantage.

A NEW GLOBAL SPACE RACE

Before a country can be a serious player in the military space realm it must buy or develop two distinct technologies: launch vehicles and satellites. Launch technology requires building rockets, rocket engines, and spaceport facilities to put payloads into space. Satellite technology, in a addition to satellites themselves, encompasses earth-bound support systems including control centers and receiving stations.

Developing countries also are gaining access to space services for civilian use, often for legitimate purposes. These include civilian telephone communications and monitoring the earth's surface to detect oil, gas, and other deposits of natural resources. The problem is that these same capabilities often can be used for military purposes.

The first step for any country with hopes of developing its own space program is to build a fleet of space launch vehicles, known simply as SLVs, to put its satellites in orbit. The list of Third World countries that have or are developing SLVs is small but growing. Such countries as India, Iraq, and Israel have joined such older space powers as the U.S. and Russia in developing and testing their own launch vehicles. Other countries known to be working on SLVs include Brazil, Indonesia, South Africa, and South

7 General Donald J. Kutyna, "Briefing to the Greater Colorado Springs Economic Development Council," March 21, 1991, p. 2.

Korea. Any country capable of putting a satellite in orbit is at best a short step from being able to deliver weapons over intercontinental distances.

Prior to the Persian Gulf War, Iraq possessed an ambitious SLV development program. This was headquartered at the Al-Anbar Space Research Base outside Baghdad. Iraq's progress became evident on December 5, 1989, when Saddam Hussein's regime tested a three-stage launch vehicle.[8] The booster, known as the *Al-Abid*, has not been tested since the Gulf War, and data are scarce regarding the status of the program in the wake of the allied bombing campaign.

India's SLV program has been up and running since the 1970s and is the most advanced in the Third World outside of China. India has three launch sites and launched its first satellite in 1980. Delhi's near-term goal is to launch a remote sensing satellite on a four-stage launch vehicle. By the end of the decade, the Indians intend to produce a launch vehicle with enough power to deploy a large satellite in distant orbit, 22,300 miles above the earth.[9]

Israel also has developed its own SLV, known as the *Shavit*, which has been used to launch two experimental satellites into space. Israel even has offered the *Shavit* to America's National Aeronautics and Space Administration (NASA) as a candidate for its *Comet* commercial launcher program.[10]

Other countries are working aggressively to catch up with these new space leaders. Brazil is developing a family of launch vehicles, several of which are based on its indigenously manufactured, sub-orbital *Sonda* rocket. Brazil's VLS rocket, as an SLV, will have more power than the *Sonda* variants. Indonesia reportedly is working with the People's Republic of China to build a domestic launch site and boosters.[11] South Korea has a goal of launching a 1,100-pound satellite by 1996.[12] South Africa is working to modify an Israeli-designed intermediate-range ballistic missile, know as the *Jericho II*, for use as a space launch rocket.[13]

New Eyes in the Sky. Predictably, the countries working hardest to build their own satellites are the same ones now developing launch vehicles. Before the Persian Gulf War, Iraq reportedly contracted with Brazil to build a military reconnaissance satellite using Chinese and French technology.[14] Brazil is among the most advanced Third World countries in satellite technology. Its military already has satellite communications systems, including the *Brazilsat* series, which was launched by Europeans. The Brazilians also have an extensive space cooperation arrangement with the People's Republic of China, which includes provisions for sharing satellite technology.[15] Brazil is

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8 Michael R. Gordon, "Iraq Announces Test of a Rocket; U.S. fails to Confirm Launching," *The New York Times*, December 8, 1989, p. A-14.

9 Thomas G. Mahnken, "Why Third World Space Systems Matter," *Orbis*, Fall 1991, p. 571.

10 Craig Covault, "Israeli Rocket Proposed to NASA For U.S. Commercial Booster Project," *Aviation Week & Space Technology*, October 1, 1990, pp. 100-101.

11 Mahnken, *op. cit.*, p. 573.

12 Robert D. Shuey et al., *Missile Proliferation Survey of Emerging Missile Forces*, Revised (Washington, D.C., Congressional Research Service, 1989), p. 82.

13 "South African Missile Test," *Jane's Defense Weekly*, July 15, 1989, p. 59.

14 Mahnken, *op. cit.*, pp. 569-570.

planning to deploy four satellites—two remote sensing satellites and two data collection satellites.[16]

India will have the Third World's most advanced satellite fleet, with both earth-observing and communications systems.[17] Israel has deployed two satellites, *Offeq-1* and *Offeq-2*, widely assumed to be military reconnaissance satellites.[18] It also is widely assumed that Israel is planning to deploy is own satellite system with a full range of military intelligence functions, including electronic eavesdropping. Further, Israel is building communications satellites to be launched for them by Arianespace, which is an arm of the European Space Agency.[19] Pakistan built an experimental satellite, the *Badr-1*, launched for them by the Chinese in 1990.[20] Indonesia operates a constellation of communication satellites known as the *Palapa* series, launched by the U.S. starting in 1976; *Palapa* soon will carry the Cable News Network (CNN) signal to South Asia.[21] South Korea has plans to deploy an experimental satellite by 1993 and a communications satellite by 1995.[22] Finally, Taiwan has authorized a $600 million program to deploy a scientific satellite by early in the next decade.

Budding Market for Satellite Services. Building national satellite systems is only one way, and not necessarily the most cost-effective, for developing countries to obtain satellite services. Two enterprises make satellite images available on global commercial markets: The first is the Earth Observation Satellite Corporation (EOSAT), a U.S. company which operates the *Landsat* constellation; and the second is the SPOT Image Corporation, a French company that operates the SPOT (*satellite pour l'observation de la terre*) constellation of satellites. Customers can purchase images from either of these companies for what ever purpose they want. Further, nine Third World countries possess either *Landsat* or SPOT receiving stations, which allow them to process satellite data on site. These are Argentina, Brazil, Ecuador, India, Pakistan, Saudi Arabia, South Africa, and Thailand.[23]

While the resolution of *Landsat* and SPOT satellites images fall far short of U.S. military spy satellites, they are good enough to monitor some surface ships and discern terrain.[24] *Landsat* satellites can detect such things as ports and harbors.[25] The quality of

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15 Evanildo da Sailveira, "Satellite Construction Program Resumed With China," *Jornal do Brasil*, December 9, 1991, p. 1-11. Translation from Portuguese in the Foreign Broadcast Information Service *Daily Report* for Latin America, January 28, 1992, p. 16.

16 Brian Davidson, "Brazil's Space Ambitions, *Aerospace World*, February 1992, pp. 74-76.

17 Mahnken, *op. cit.*, pp. 571-572.

18 "Israel Orbits Offeq-2 Spacecraft," *Aviation Week & Space Technology*, April 9, 1990, p. 20.

19 Simson L. Garfinkel, "Israel Shoots for a Moon," *Christian Science Monitor*, May 15, 1990, p. 13.

20 Mahnken, *op. cit.*, p. 573.

21 Stephen F. Stine, "CNN, ESPN to Use Indonesian Satellite For Home Viewer Programming in Asia," *Wall Street Journal*, August 30, 1991, p. B-3.

22 Mahnken, *op. cit.*, p. 573.

23 *Ibid.*

24 *Ibid.*, p. 568. The current *Landsat* capability produces satellite images with a resolution 32 yards, while SPOT images have a resolution of 11 yards.

25 *Ibid.*

SPOT images is good enough that the U.S. military could have used them to assist in bomb damage assessment during the Persian Gulf War.

A new player in the commercial satellite imaging business will be Russia. Strapped for hard currency, Russia likely will sell imagery through its *Soyuzkarta* space agency, which occasionally has sold images of better resolution than either *Landsat* or SPOT.

Satellite communications services also are available on the commercial market. The International Telecommunications Satellite Organization (Intelsat), an international organization that coordinates international satellite communications among its member countries, operates a global satellite communications system. While the Intelsat system is designed for civilian use, it can be used to support military operations. The U.S. military used the Intelsat network during the Gulf War to complement the armed forces' own military communications system.[26]

Other satellite services also are available on the open market. The U.S. government's National Oceanographic and Atmospheric Administration (NOAA) operates a weather satellite constellation, providing weather services to 120 countries around the globe. Even satellite navigation information now is commercially available. A less precise signal from America's Global Positioning Satellites is available for anyone, from private aviators to hostile forces, possessing a unit to receive the signal. While not as accurate as the military GPS signal, many military missions such as coordinating large-scale troop movements do not require high accuracy.[27]

INEFFECTIVE CONTROL EFFORTS

The U.S. has not been nearly as concerned about the proliferation of space technology as it has about the spread of biological, chemical, and nuclear weapons. This negligence is misguided. Military space systems are "equalizers" that can allow even small powers to pose a threat to America and its forces in the field. The main space technology control effort has been the Missile Technology Control Regime (MTCR), but this addresses only part of the problem, and indirectly at that. MTCR's main purpose is to control the transfer of technology needed to design and build surface-to-surface missiles. It does not address directly the question of controlling the spread of space rockets.

Initiated by the U.S. in 1987, the MTCR now has eighteen participating countries.[28] Because ballistic missile technology is closely related to space rocket technology, the MTCR indirectly serves to limit Third World access to space rocket systems. But because the MTCR itself states that it is not meant to impede Third World space programs, it opens a tremendous loophole in the control regime. Already states have sought to take advantage of this. When it was announced this May 8 that Russia agreed

26 The Department of Defense, *Conduct of the Persian Gulf Conflict op. cit.*, p. 15-2.

27 Commercially available GPS signals establish a location on earth to within about 100 yards. The encrypted military signal is accurate to within less than 10 yards.

28 The countries now participating in the MTCR are: America, Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Great Britain, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Spain, and Sweden.

to sell rocket motors to India's Space Research Organization, the Indians argued the agreement was not a violation of MTCR because the Russian rockets were designed for use in a civilian space program. Nevertheless, the State Department announced on May 11 that the U.S. was imposing sanctions on both the Indians and the Russians because it viewed the agreement as inconsistent with MTCR guidelines, which limit the export of rocket systems capable of delivering a 1,100 pound payload at least 185 miles —a mission these motors certainly could achieve.

The primary obstacle in the effort to control space technology is the presumption in the international community that all countries are entitled to access to space. This principle even is embodied in a treaty. The 1967 United Nations Treaty on Outer Space states: "The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind."

To overcome this obstacle, developing nations must be given a stake in curtailing the proliferation of military space technologies. Most spacefaring nations, both developed and less developed, pursue space programs for distinctly national reasons. The security problems associated with space technology proliferation will not be resolved until developing countries are convinced that their interests are best served by cooperating with efforts to control space technology proliferation.

CONTROLLING THE PROLIFERATION OF SPACE TECHNOLOGY

In seeking more effective control over the spread of missile technology, the U.S. must balance carefully the legitimate needs of developing countries for space systems with the need to stem the spread of military space technology, especially to potentially hostile states. Toward these ends, the U.S. should:

✔ **Strengthen arms control measures restricting the proliferation of space launch systems.**

The Missile Technology Control Regime, the only significant multilateral space technology proliferation effort, contains a major loophole: it exempts national civilian space programs from its controls and sanctions. The MTCR states specifically it is "... not designed to impede national space programs...." Thus MTCR now draws an arbitrary distinction between military ballistic missiles and commercial space launch vehicles, mandating measures to discourage one but not the other. In practice, of course, the technology needed to build a commercial launch vehicle, including rocket engines and advanced materials, is virtually identical to that needed to produce a military ballistic missile. This seriously weakens MTCR, as demonstrated by the current flap with Russia over its decision to sell rocket motors to India.

The language exempting national space programs should be struck from MTCR. The exemption implies that the transfer of space technology, specifically SLV technology, does not constitute a military threat. In fact, it does. Robust efforts to develop space technology by such leaders as North Korea's Kim Il Sung—also hard at work on an atomic bomb—even in the face of dire poverty at home, indicate that hostile foreign leaders see military and political leverage to be gained through their ostensibly peaceful national space programs. If these leaders were serious about using space for peaceful purposes and to assist national development, they simply would use the far cheaper launch services now available in developed countries rather than pursuing their own, expensive development programs merely to duplicate forty-year-old technology. The only possible advantage of an indigenous space program, for the Kims of the world, is the ability to launch military payloads into space. These leaders cannot be permitted to develop this capability due to MTCR's "space program exemption" loophole.

✔ **Propose an International Space Technology Cooperation Initiative.**

While the MTCR rightly helps deny technology to such outlaw states as Iraq, Libya, and North Korea, it does nothing to limit access to satellite technology. It also penalizes the vast majority of non-threatening developing states, many of which have legitimate requirements for access to space and to space systems. To ensure this access while helping to stem proliferation, the U.S., Europeans, Japanese, Russians, and other spacefaring nations should propose an International Space Technology Cooperation Initiative (ISTCI) with the legal force of a treaty. This initiative would guarantee non-spacefaring states full access to commercial satellite services on a competitive basis, in return for agreement not to develop their own space launch vehicles or satellite systems or divert commercial services to military purposes.

This agreement would be in the interests of developing countries, which would gain guaranteed access to needed space services far more cheaply than they could by developing their own capabilities. Developed countries would benefit by establishing an international regime that would help to stem the proliferation of space systems and their inherent military potential. By giving developing nations, as well as technology supplier states, a stake in the new regime, ISTCI would enhance the legitimacy of the anti-proliferation regime now in place under MTCR. By the same token, supplier or recipient states refusing to cooperate in the new regime could be better isolated and other anti-proliferation efforts concentrated against them. This, too, benefits developed and developing nations with a stake in maintaining regional stability and balances of power.

Under ISTCI, export restrictions on satellite technology could mirror the MTCR. A list of satellite technologies subject to control also would have to be compiled, ideally by negotiation between space technology supplier and recipient states, with the heavy involvement of commercial enterprises now offering space services. Such technologies would include sensors, electronic communications systems and computer processors.

Reserving the Right. Under the ISTCI regime, supplier countries would be able to share military satellite information with a Third World ally for security reasons, although the export of space technologies for military purposes would be barred. Even so, the U.S. should make clear to other supplier nations that it reserves the right to jam satellite signals and, if need be, shoot down any satellite determined to be assisting a country engaged in hostilities against U.S. forces.

One objection to ISTCI could be that it might deprive developing countries of potentially lucrative markets in commercial space services. At the moment, however, the only Third World country capable of competing in the SLV and satellite production market is China. Thus, the ISTCI would not represent widespread discrimination against commercial space enterprises in the Third World. If, however, the ISTCI were to work properly, China would have to join as a supplier state. Programs in the most developed countries to reduce further the cost of space systems, such as the McDonnell-Douglas Space Systems' proposed Single-Stage-To-Orbit (SSTO) launch system, only will create a wider gap between the cost of Third World space systems and those of the developed world in coming years. SSTO, when combined with new smaller and lighter satellite designs, will allow the U.S. to deploy systems that perform the same functions as less advanced technologies likely to be used in Third World satellites at a fraction of the cost. From an economic perspective, the Third World would be better off just buying the much cheaper service.

Verification of ISTCI would not be difficult since SLV production programs, construction of launch facilities, and satellites in orbit, would be nearly impossible to conceal. The U.S. long has had the capacity to detect and track both rocket launches and satellites in orbit. Diversion of commercial satellite services to military use would be more difficult to detect, but doing this over a long period of time would be difficult to conceal.

ISTCI would not necessarily require the participation of all the world's space technology suppliers at the outset. The U.S. could bring together a small group of supplier and recipient nations to demonstrate the advantages of participation. Latin America might be a good place to start, since competition between Argentina and Brazil in space systems is proving expensive to both, and both countries are beginning to cut back on the production of space technologies. Developed nations could join the U.S. in making space services available on a competitive basis throughout Latin America in exchange for commitments to abandon indigenous SLV and satellite programs. If the Latin American plan succeeds, the U.S. then could seek to expand the list of supplier and recipient nations. The long-term goal should be global participation.

✔ **Develop a national policy to secure U.S. commercial satellite signals, including in some cases encrypting commercial satellite data.**

Given the wide array of satellite services available on the commercial market, including earth-observation, position locating, and weather observation, new ways must be found to deny access to these services during wartime or other national security crises. The best way to ensure that a belligerent country such as Iraq cannot "piggy back" on commercial satellite services for military purposes, is to "encrypt" satellite signals. Unauthorized personnel cannot decipher these signals because they are transmitted in secret code. This option certainly is more attractive than shooting down commercial satellites during wartime, when U.S. forces likely will need the services.

The relatively easy access to the Pentagon's Global Positioning System (GPS) reveals the scope of the problem in limiting the use of commercial satellite data.[29] GPS provides precise position location and navigation information for military forces. Its signals even can be used to guide such weapons as strike aircraft and cruise missiles to their targets. These military signals are encrypted so that only U.S. military forces can use them. GPS also emits unencrypted signals for such commercial users. These sig-

29 A detailed discussion of the security implications of unrestricted availability to the GPS network can be found in a December 9, 1991 briefing given to the Pentagon's Proliferation Countermeasures Working Group by Steve Wooley of the Institute for Defense Analyses.

nals do not contain information as precise as the encrypted military signal (known as the "p" signal) and therefore cannot by themselves be used for military targeting. Units capable of receiving these unencrypted code are widely available, and their price currently is around $500 and falling.

Crackable Code. This "two tiered" GPS system—the first tier an accurate, encrypted code for U.S. military forces, and the second a less accurate, unencrypted code for commercial users—is not working very well. To obtain the same information as those who know GPS's secret codes, an unauthorized commercial user need only compare a known position with the inaccurate commercial GPS signal compute the difference between the two, and apply this differential to the GPS signal they receive. The result, known as the "differential GPS," already is offered by electronics companies on the open market. Commercial users who buy this information will, in effect, have the same access to GPS's capabilities as the U.S. military.

Stronger encryption policies for U.S.-owned commercial satellite signals are necessary. The U.S., for example, could encrypt all GPS signals, not just the military's accurate signal, and change encryption signals periodically to prevent easy circumvention of the security system. Information needed to decipher the code could be provided as needed to legitimate commercial users. This would reduce access to GPS by unauthorized users. During wartime or crises, codes could be changed frequently, and even authorized commercial users shut off altogether if deemed necessary by the President to protect national security.

This policy will not deprive commercial interests of access to satellite services. They will subscribe to them in much the same way that owners of television satellite dishes must obtain a decoding box to gain access to cable programming. While it will cost American taxpayers over $1 billion to develop, produce and deploy the GPS system in the first place, commercial users obtain access to this system merely for the cost of a satellite signal receiver. A subscription system for marketing the encrypted GPS signal, however, would allow taxpayers to recoup at least a portion of their investment, while helping to safeguard national security. This same principle of selective availability should be applied to other U.S. commercial satellite systems.

✔ **Develop capabilities to attack enemy satellites in the event of conflict.**

No regime of export controls or arms control can be expected forever to stop the transfer of space technology to the developing world. Eventually, some proliferation is inevitable. The U.S. military, therefore, must be prepared to combat future military space threats as they arise.

In future conflicts the U.S. may find that it needs to enforce a "keep out" zone in space over a battlefield. This will mean developing a capability to shoot down enemy satellites. Such weapons could be land-based or space-base rockets that destroy enemy satellites by smashing into them at high rates of speed.

The U.S. does not have an operational anti-satellite (ASAT) weapon, and the program to build one is moribund. This year the Pentagon is asking for $25 million for ASAT research and development, down from $51 million in 1992 and $91 million in 1991.[30] The Army Strategic Defense Command, the lead ASAT agency, estimates that ASAT production, let alone deployment, now cannot commence before 1997.[31] Disarray in the ASAT program to a large degree is the result of liberal opposition in Congress. Congressman George Brown, the Democrat from California, has been particularly adamant in his opposition to this program, sponsoring amendments that prevent ASAT tests against targets in space.[32]

The U.S. cannot afford to have its forces targeted by enemy "gunsights" in space. Congress should fund ASAT next year at the current level of $51 million, and establish a goal of testing it against a target in space before the end of 1996.

Other ASAT approaches also should be developed by the Pentagon. Most satellites convey their messages to ground stations via electronic signals. Electronic countermeasures, or jamming, can neutralize a satellite as effectively as shooting it down. Jamming enemy ground stations, however, is a complicated matter, particularly if they are mobile and include their own countermeasures. Better jamming techniques should be developed.

Also, ground stations capable of receiving satellite signals should be high priority targets in any future conflict. U.S. forces, particularly air forces, should be given special training in tracking, locating, and destroying mobile ground stations. Finally, methods for deceiving enemy reconnaissance satellites should be improved and incorporated into military training and doctrine. Example: dispersing troops and supplies and camouflaging them. Shortcomings were revealed by the concentration of military supplies that were left in the port areas of Saudi Arabia at the start of the Persian Gulf War. In one instance, an Iraqi *Scud* missile came close to hitting and destroying a large volume of supplies necessary to prosecuting the war.[33]

Developing the ability to destroy or counter enemy satellite systems will strengthen the anti-proliferation measures employed in an arms control regime. Satellites are expensive to build and to deploy in space. If Third World leaders realize that the U.S. and its allies will destroy their satellites or render them useless in case of war, they will be less likely to make the investment in the first place.

CONCLUSION

The demise of the Cold War has left the U.S. the world's preeminent space power. Together with other spacefaring nations, America should work to ensure that the commercial benefits of space are accessible to all nations. By the same token, the U.S. has an opportunity to ensure that space never is used as a venue for aggressive, expansionist states to pursue objectives hostile to the interests of the U.S. and the international community.

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30 Department of Defense, *Fiscal Year 1992/1993 Amended Biennial Budget*, January 30, 1992.

31 Briefing by Colonel Gregory Stolt, Program Manager for the anti-satellite program at the Army Strategic Defense Command, Huntsville, Alabama, May 21, 1991.

32 Representative Brown offered amendments to limit or ban entirely anti-satellite weapons tests against targets in space to the annual Department of Defense Authorization Bill throughout most of the 1980s. Many of these amendments were adopted by the entire House of Representatives, and in some instances enacted into law.

33 Henry D. Sokolski, Deputy Assistant Secretary of Defense, "Statement Before the Joint Economic Subcommittee on Technology and National Security," March 13, 1992, p. 4.

Balancing Needs and Dangers. To achieve these goals, the U.S. and other suppliers of space technology and services must balance the legitimate needs of developing and developed countries for expanded space services with the dangers posed by proliferation of space technology to such potentially hostile regimes as Iran, Iraq, and North Korea. Unless this is done, competition between satisfying the legitimate needs of Third World states for space services and anti-proliferation efforts could easily develop into another point of contention between developed and developing states. The fact is that all peaceful states, whether First World or Third World, have an interest in ensuring that militarily applicable space services do not fall into the hands of dangerous aggressors.

To control the proliferation of potentially dangerous military space technologies, the U.S. should seek explicitly to restrict Third World access to space rocket systems under the Missile Technology Control Regime (MTCR); seek an agreement between developed and developing countries that exchanges expanded space services for commitments from Third World countries not to deploy their own satellites; make U.S. commercial satellite signals available selectively; and, expand the military's ability to counter enemy satellites with anti-satellite (ASAT) weapons.

Taken together, these measure will serve both to limit the proliferation of militarily significant space technology and improve the ability of the U.S. military to handle an expanded space threat from hostile countries.

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